Challenges in Connecting Cumulative Effects Analysis to Effective Wildlife Conservation Planning

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Wildlife populations are affected by habitat loss and fragmentation resulting from actions undertaken by various parties across broad geographic scales. One way to account for these effects is through cumulative effects analysis (CEA), a legal requirement under the National Environmental Policy Act that has been a persistent challenge for natural resource agencies. This article provides an overview of the CEA requirement, and uses the US Forest Service's approach as a platform for assessing the promises and pitfalls of connecting CEA to effective wildlife conservation planning. I conducted a case study analysis, using document analysis and interviews, to investigate CEA practice and its associated challenges. I found that current CEA practice relies on habitat-based measurements and fails to account for long-term or broad-scale impacts, resulting in a disconnect between the approaches taken to CEA and accurate understanding of biological effects. Insufficient monitoring stands out as the primary impediment to improving CEA. Increased monitoring, improved knowledge of species-habitat relationships, and the development of scientifically credible assessments are potential ways forward.

Keywords: wildlife conservation planning, cumulative effects analysis, monitoring, forest planning

One of the most challenging and controversial aspects of national forest planning is how to tackle broad-scale biodiversity conservation (Noon et al. 2003, 2008, Cushman et al. 2008). The National Forest Management Act of 1976 (NFMA) requires the US Forest Service (USFS) to "provide for diversity of plant and animal communities." The USFS's 1982 planning regulations gave further definition to the diversity provision, stating that the agency must "maintain viable populations" of vertebrate species (36 C.F.R. § 219.19 [2000]). Over the last decade, several attempts have been made to revise the USFS's planning regulations, and provisions for protecting wildlife have been especially controversial. A Committee of Scientists (1999) recommended an increased reliance on focal species and population monitoring, and the Clinton administration included those requirements in the 2000 planning rule (65 Fed. Reg. 67514). That rule was set aside by the Bush administration, which issued new rules in 2005 and 2008—both of which were enjoined for failure to comply with existing environmental laws (see, most recently, *Citizens for Better Forestry v. USDA*, 2009). The 2005 and 2008 rules relied largely on the preservation of coarse-filter ecosystem diversity as a proxy for wildlife conservation; the approach caused some consternation, given that its efficacy is essentially untested (Cushman et al. 2008, Noon et al. 2008). The Obama administration is in the process of again revising the planning regulations (see *http://fs.usda.gov/planningrule*).

Another prominent issue in forest planning has been the question of cumulative effects. Cumulative effects analysis (CEA) is done in accordance with the National Environmental Policy Act of 1969 (NEPA)—a statute that requires federal agencies to conduct environmental impact assessments in the United States and that has been copied in some form by a number of US states and more than 130 other countries (Rasband et al. 2009). The NEPA regulations define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (The NEPA regulations define cumulative effects and cumulative impacts synonymously, and the terms are used interchangeably throughout this article.) As part of CEA, agencies must consider the effects of their actions when viewed in concert with other events and actions that may cumulatively contribute to significant environmental change. The analysis is

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particularly relevant for resources such as wildlife populations that potentially see effects over large spatial scales and long periods of time.

Over the last 15 years or so, federal agencies have seen a rise in CEA-related legal challenges, and the USFS in particular has lost numerous cases; between 1995 and 2004 the agency lost nearly 75% of published cases on this matter in the Ninth Circuit (Smith 2006). Scientists have identified CEA as a key aspect of effective biodiversity conservation in national forest planning, and one that was threatened by recent planning rule revisions (Oversight Hearing 2007). The USFS also in the past has identified CEA as one its primary planning challenges, explaining that CEA has not been handled effectively at the forest-plan level (73 Fed. Reg. 21468).

Past studies have found that CEA was absent or inadequate in many NEPA documents, and that the requirement has not been implemented to its full potential for numerous reasons, including a lack of monitoring data, funding, and adequate training (McCold and Holman 1995, Burris and Canter 1997a, 1997b, Smith 2006). This article builds upon past studies by looking in detail at a case study of how the USFS currently conducts CEA, particularly for wildlife populations. The goals of this research were to understand how the agency performs wildlife CEA, determine whether its methods are scientifically sound, identify impediments to improvement, and consider ways forward.

Methods

Previous research on CEA has looked generally at the presence and quality of CEA in NEPA documents across federal agencies. When research in the field has been more broad, a case study is warranted (Gerring 2004). I used a national forest that has faced litigation on this issue in the Ninth Circuit, where the majority of CEA litigation has occurred (Smith 2006). Because of the numerous legal challenges on this matter against the USFS, particularly in the Northern Region, one could expect the USFS in this region to be paying relatively close attention to the CEA requirement and how to improve practice, as compared with other agencies. The Idaho Panhandle National Forest (IPNF) was involved in an important and high-profile decision involving CEA and wildlife analysis, *Lands Council v. Powell* (2004), in which the court found the IPNF's approach to CEA and analysis of effects on old-growth-dependent species both inadequate. The IPNF was also involved in *Lands Council v. McNair* [2007, 2008 *en banc*], a series of cases ultimately decided in favor of the USFS that revolved around judicial standards of review with regard to agency science, particularly in wildlife effects analyses. Given the recent attention to this matter on the IPNF, the forest served as an informative case study for understanding current CEA practice and the areas of contention around the analysis.

I analyzed environmental impact statements (EISs) from 2006 to 2007 for timber-related projects, as these documents were likely to include CEAs relevant to wildlife. A two-year time frame using these parameters yielded four EISs (USFS 2006a, 2006b, 2007a, 2007b; this research was part of a larger project that also included the development of a legal and administrative history of the CEA requirement and a comparison of the EISs from 2006 to 2007 with a sample from 2002 to 2003). I also conducted qualitative, semistructured, and confidential interviews. Interviewees were identified through purposive and snowball sampling (Singleton and Straights 2005). I interviewed 32 individuals, including USFS staff, line officers, lawyers, and scientists, as well as outside scientists and staff members from environmental groups that comment on CEAs, for this project.

Current wildlife CEA practice on the IPNF

The IPNF's 1987 Forest Plan, which is still in effect, states that the forest will maintain viable populations of vertebrate species in the planning area, generally understood to be the entire forest (USFS 1987). To comply with the USFS's viability requirement, the Ninth Circuit federal appellate court has deemed it appropriate for the agency to use measurements of habitat availability as a proxy for direct measurements of population status (see *Inland Empire Public Lands Council v. USFS* [1995]). The agency also can use surrogate species as proxies for other species. This has been called the proxy-on-proxy method and is still valid practice in the Ninth Circuit (*Lands Council v. McNair* [2008 en banc]).

The IPNF analyzes effects on threatened and endangered species, regional forester sensitive species, and management indicator species. Although the IPNF does some monitoring of species presence, such as inventorying and monitoring northern goshawk (*Accipiter gentilis*) nest sites, it does not have data on population trends for species on the forest. The Rocky Mountain Research Station is researching the population status of several species, including marten (*Martes americana*) and fisher (*Martes pennanti*). Population estimates from those efforts are not currently available in the published literature and are not used by the IPNF in NEPA documents. Estimates of population numbers are available for several species, such as the grizzly bear (*Ursus arctos horribilis*) and woodland caribou (*Rangifer tarandus caribou*). For all other species, population data are not presented in the CEA for wildlife. CEAs rely upon habitat-based effects variables almost exclusively, and the IPNF is not unusual in this way. The USFS has not directly monitored the populations of indicator species in a way that would allow for understanding population responses to management actions (Noon et al. 2008), and interviewees suggested that the practice of relying on habitat-based effects variables is common across the public land agencies.

On the IPNF, cumulative effects are generally analyzed at the scale of the project area. The reasons given for this are that the project boundary (a) is often the size of multiple home ranges for species, (b) reflects topographic features that govern species movement, and (c) represents the point of diminishing effects. By this, the USFS means that beyond the project boundary, project effects are too small relative to the landscape to be meaningfully analyzed. This raises the critical question of whether and at what point larger-scale and forestwide assessments of viability and cumulative impacts are undertaken. For most species, limiting CEA to the project area is insufficient for understanding cumulative impacts at the population scale (Ruggiero et al. 1994).

Several examples can provide an overview of the various approaches of the IPNF to wildlife CEA. For example, Canada lynx (*Lynx canadensis*) are managed according to the framework of the Lynx Conservation Assessment and Strategy (Reudiger et al. 2000), developed in cooperation with the US Fish and Wildlife Service after lynx were listed under the Endangered Species Act of 1973. For lynx and several other species, the IPNF uses a timber stand database to determine the availability of capable and suitable habitat and verifies estimates through aerial photos and field visits to the project site. In areas of suitable lynx habitat, the USFS designates theoretical home ranges for individual lynx. Within these home ranges, the USFS abides by management standards that serve as cumulative impacts thresholds for habitat alteration both spatially and temporally. For example, at least 10% of the habitat must be in suitable denning condition, and the USFS may not convert more than 15% of lynx habitat to an unsuitable condition within 10 years. No management action would be viable if it exceeded these guidelines, and cumulative effects are deemed insignificant as long as these standards are met.

For other species, guidelines and thresholds for CEA are less clear. Fisher, for example, do not benefit from a management strategy or cumulative impact thresholds. Interviewees and IPNF documents suggest that there are viability concerns for fisher on the IPNF (USFS 2006a), and the Northern Rockies population of fisher is currently under review for listing under the Endangered Species Act. Effects to fisher populations, like those to lynx, are analyzed in terms of acres of suitable habitat in the project area, determined using timber stand data. According to the IPNF, fisher habitat is difficult to model because of a lack of information on habitat requirements and limitations in accounting for various habitat characteristics using timber stand data (USFS 2006a). The IPNF's approach is to maintain the quality of subdrainages based on the percentages of mature or old-growth timber, and to limit effects through other management guidelines focused on the preservation of mature or old-growth stands, riparian areas, and coarse woody debris (USFS 2006a, 2007b). Presumably, as long as no project degrades the quality of any subdrainage, projects are not creating any additional threats to viability, aside from those that may already exist. However, without more knowledge about population status and wildlife-habitat relationships, it is difficult to be confident that these guidelines for maintaining fisher habitat are effective.

Accounting for past actions and their impacts on species is also a central issue with regard to cumulative impacts. There has been significant controversy over this matter in recent years, and in 2005 the Council on Environmental Quality issued guidance that an agency generally can capture the cumulative impacts of past actions by describing current conditions in the aggregate (see CEQ 2005 and USFS regulations based on this guidance at 36 CFR §220 [2008]). In the lynx analyses, past activities are considered in general, qualitative terms. For example, one EIS explains, "The road construction associated with [past] sales increased access for trappers and snowmobilers, potentially causing negative impacts to lynx through increased trapping mortality and snow compaction allowing access to lynx habitat for competing predators" (USFS 2006a, p. 4-59). No more specific detail is given about the effects of past actions on habitat availability or lynx populations. The section concludes: "These activities would not have cumulative significant impacts when added to the proposed action, since the effects are already incorporated into the environmental baseline" (USFS 2006a, p. 4-59). This statement is at the close of nearly every single CEA for wildlife in the EISs reviewed. However, there is no obvious basis for the conclusion that the species has not sustained significant cumulative impacts. The management strategy is meant to prevent further significant cumulative impacts to lynx populations and the loss of any suitable home ranges. However, there are no estimates of actual lynx population numbers, historic population declines, or indications of whether the species has already sustained significant cumulative impacts on the IPNF.

Similar issues arise in the fisher CEAs. The Mission Brush EIS (USFS 2006a) explains that past harvest had the potential to eliminate some fisher habitat, although it includes no estimates of how the availability of fisher habitat has changed over time on the forest, on a population scale, or in the project area. The CEA for past activities concludes: "In combination with past natural and human-caused events, the proposed action would reduce the quantity of suitable fisher denning habitat. However, given the low density of fisher populations, it is unlikely that they are limited by denning habitat. Previous activities would not have cumulatively significant impacts when added to the proposed action, since the effects are already incorporated into the environmental baseline" (USFS 2006a, p. 4-79). An implicit assumption in this analysis is that the species is so rare that some additional habitat loss is insignificant. However, species-habitat relationships, by the USFS's own admission, are poorly understood for this species, making it difficult for the IPNF to know what the effects of further habitat loss and fragmentation might be, or whether this area might be supporting some critical portion of the small population that remains.

It is also impossible to know what types of effects would lead the IPNF to conclude that there would be significant effects to fisher populations. The concluding assertion that there are no significant impacts rings hollow without an attendant explanation. Imagine instead that the analysis stated: "Past effects are incorporated into the environmental baseline and proposed actions would not have a cumulatively significant impact because we are still not reaching threshold x." In this case, the red flag is clear in terms of significant cumulative effects. However, the lack of management thresholds allows small portions of habitat to be eliminated incrementally without any signal when the loss of habitat might constitute a significant cumulative impact. Minimum thresholds for viability are undoubtedly difficult to establish (Tear et al. 2005). However, some kind of threshold or trigger point, which could be expressed as a range of conditions to incorporate uncertainty and reflect a distribution of ecological conditions, is needed to provide a basis for conclusions regarding the significance of impacts and to provide some context for project-level impacts.

As was the case with lynx, there is also no clear accounting of what has been lost in terms of fisher habitat or populations in the area, and whether the fisher population has already sustained significant cumulative impacts. Current conditions for this and other species are not compared with any point in the past, making it impossible to understand cumulative impacts. Historical information is central to a CEA, which is about whether thresholds are being crossed and also how current conditions compare with past conditions (McCold and Saulsbury 1996, MacDonald 2000, Eccleston 2006). If population data were unavailable, the USFS could provide information on habitat loss for individual species, which might give some indication of possible cumulative impacts.

Without thresholds or perspective on past actions, there is little information to provide context for projects that eliminate small portions of habitat and no real assessment of cumulative effects, either generally or as a result of management actions, on fisher populations over time. As a result, this approach to CEA has limited power to affect decisionmaking. Additionally, because there are no population estimates and no forestwide analyses of the status of the species, it is impossible to know if the forest is supporting what might be considered a viable population.

As a last example, consider the CEA approach for pileated woodpeckers, a management indicator species on the IPNF. Timber stand data are used to identify suitable habitat, and hypothetical 1000-acre home ranges are delineated around suitable nesting stands, with effects analyzed using required parameters for each home range. Cumulative effects are assessed by looking at all home ranges across the project area. The lack of perspective on past actions and effects is again a limitation. One EIS (USFS 2007b) explains that past logging projects have decreased habitat, but concludes that there are no significant cumulative impacts because effects are embedded in the current environmental baseline. Again, this does not tell us how many home ranges may have been lost in the past as a result of harvest and whether the current number of home ranges forestwide is sufficient to support a viable population. In this case, two agency assessments support the finding of no significant cumulative impacts. One enumerates minimum habitat thresholds for viable populations of pileated woodpeckers and other old-growth-dependent species and finds that ample habitat remains on the IPNF (Samson 2006b). The other finds that the short-term viability of the pileated woodpecker is not threatened because of the abundance and distribution of habitat across the IPNF and the region (Samson 2006a).

This work is potentially useful in that it sets some thresholds and takes a regionwide look at the viability of the pileated woodpecker and several other species. However, it suffers from several problems, the most prominent being that the analysis is based entirely on habitat availability, which alone is insufficient for understanding the status of populations (Noon et al. 2003, Mills 2007). Additionally, some interviewees, both from inside and outside the agency, stated that a team outside of USFS management should have done the assessment; some interviewees also thought the work should have been peer reviewed, especially if it was conducted by USFS management, and several were skeptical that it would survive such review. As one interviewee with the USFS put it, there is no doubt that such work should be peer reviewed if it is going to be assigned so much weight in project-level analyses, but there is nothing in the law that requires such action. Advocating for peer review of agency science is a complicated matter that deserves caution, but it is precisely this type of assessment—one that guides effects analyses for a key resource across multiple forests—that would benefit from outside review (Doremus and Tarlock 2005). However, the agency is legally allowed to rely upon its own internal assessments as the best available science unless there is clear and overwhelming evidence that such assessments are scientifically unsound. Courts typically defer to agency science, even if it has not been published or peer reviewed, and even when it may contradict other scientific information (Schultz 2008).

Challenges associated with current CEA practice

The goal of this work is not to criticize the IPNF in particular. Instead, the aim of this article is to use the IPNF's CEA as an example of current practice, and to consider some challenges and limitations associated with this approach to wildlife CEA. The requirement is undoubtedly difficult to implement, as is multispecies wildlife conservation planning in general. However, it is useful to consider the primary challenges associated with completing CEAs for wildlife and investigate how to improve current practice so that future CEAs more effectively comply with the goals of NEPA and provisions in NFMA.

The IPNF's current approach to understanding impacts to species is limited in several key areas. As numerous interviewees explained, habitat-based analysis alone cannot meet the USFS's obligations to protect biodiversity (Noon et al. 2003, Mills 2007). The USFS is not legally required to monitor populations directly; however, this does not mean that current practice is effective. The agency's approach depends on several key assumptions: (a) habitat is a useful indicator of population status, (b) the way that habitat is designated is an accurate proxy for the habitat requirements of species, and (c) the habitat needs of species are known—the empirical support that such assumptions are being met is minimal (Cushman et al. 2008, Noon et al. 2008). Current

USFS practice also depends on management guidelines for structural components such as snag habitat, surrogate species, and standards like the IPNF's 10% old-growth standard. Without direct monitoring of populations, it is impossible to know whether these approaches are effective.

Another problem is a lack of assessment of how population status or habitat availability has changed over time and space. In order to meaningfully understand effects on wildlife, CEA must be conducted not at the project scale but at larger scales that capture the effects of multiple actions on populations; the disparity between the scale of individual management actions and the scale at which populations respond is a persistent problem in understanding effects on population viability (Ruggiero et al. 1994). Current and past conditions also are not compared, making it impossible to understand cumulative impacts over time. A number of USFS interviewees explained that if a project is going to have only minimal effects on a species, an understanding of how that species has been affected over time might be interesting, but is not important for informing the present decision. This argument echoes the guidance from the Council on Environmental Quality (2005). However, this approach fails to meet the intent of both the NEPA and NFMA. The NEPA is meant to inform the agency and the public about effects, with CEAs emphasizing long-term, synergistic effects. Even if a species is not at a viability threshold, NEPA's disclosure requirements lend credence to the notion that a CEA, at some level of planning, should include a picture of significant changes to a resource over time (Eccleston 2006). The critical question is at what stage of planning, be it forest planning, ongoing monitoring and assessment, or project planning, this level of analysis should occur.

The USFS also has a legal obligation under NFMA to protect species diversity; effective species conservation requires some kind of landscape- or population-level analysis, both to assess population status and to provide some basis for assertions in NEPA analyses that project-level effects are insignificant. Furthermore, diversity and viability standards under NFMA play a companion role to the Endangered Species Act and serve as a tool for recognizing species declines before viability thresholds are crossed (Crumpacker 1998). If managers focus exclusively on current conditions without considering long-term impacts, population declines might not be addressed until a crisis becomes apparent.

Impediments to improving CEA

Interviewees cited the lack of monitoring information as the primary impediment to improving CEA. USFS staff explained that implementation monitoring and cause-effect monitoring are both needed in order to understand the effects of management actions and assess cumulative impacts. According to many USFS interviewees, sufficient funding and staff are not available to conduct effective monitoring. Others explained that monitoring may occur more consistently when it is emphasized and prioritized by line officers. Interviewees noted that the agency is developing a more comprehensive monitoring program with the assistance of USFS researchers and on the basis of direction from the Washington office. However, even a well-designed monitoring program will be ineffective if it is not supported with adequate funding and personnel.

Despite its fundamental importance, monitoring has been a persistent challenge in natural resource management, and it has been difficult to maintain the political and fiscal will to support long-term monitoring efforts (Doremus 2008). There are considerable political disincentives to collecting monitoring information, which can be used against the agency to reveal that management practices have had detrimental effects. The agency also may face legal vulnerabilities if it commits to monitoring that it then fails to complete, as a result of a lack of funding or other reasons. From a legal standpoint, in the case of wildlife there is little that compels the agency to undertake direct population monitoring. The proxy-on-proxy method is acceptable practice in the Ninth Circuit, and the agency is not required to generate new information to support effects analyses (see *Inland Empire Public Lands Council v. USFS* [1995] and 40 C.F.R. §1502.22[b] [2008]). Therefore, it is critical to create incentives for managers to support increased monitoring. Congress or agencies could create such incentives and also could take steps to make monitoring a legal requirement. Statutes, regulations, land management plans, and even projects with multitiered implementation frameworks could include binding monitoring requirements that would force agencies to undertake monitoring; binding monitoring requirements might impel both Congress and agencies to allocate sufficient funding for monitoring.

USFS staff also cited other impediments, including the need for databases designed specifically to assess and model habitat, and also for empirically based wildlife-habitat relationship models. Scientists at the Rocky Mountain Research Station indicated that species-habitat research is under way that could improve the ability to undertake CEA in the future. Interviewees also explained that increased coordination is needed in order to make effective use of data that already have been collected and to design future monitoring efforts with statistically robust sampling designs. Interviewees noted that the USFS, which historically has lacked funding commensurate with its responsibilities (Burchfield and Nie 2009), has faced additional cuts to its staff and budget over the last several years, making it difficult to move forward in these areas.

Improving wildlife CEA

As part of wildlife conservation planning, agencies will necessarily rely on strategies that involve considerable uncertainty; therefore, direct, iterative monitoring of populations will be necessary to assess whether practices are effective (Noon et al. 2008, Cushman and McKelvey 2009). In order to undertake effective wildlife conservation planning, agencies and Congress must prioritize monitoring, which is essential to assessing the validity of assumptions that form the basis of agency practices, understanding cumulative impacts, and providing a foundation for learning and adaptive management. Iterative monitoring of cumulative impacts over space and time is necessary in order to accumulate the data and statistical power necessary to detect effects on populations. In the case of wildlife, future efforts should rely on the strategic selection of focal species for monitoring (Noon et al. 2003, Mills 2007), greater collaboration with research scientists, and an increased role for regional offices in coordinating the monitoring strategies of individual national forests (Holthausen et al. 2005). Genetic monitoring also has the potential to increase the information available in the future at relatively lower costs (Schwartz et al. 2006).

Monitoring must be coupled with management plans that have clearly stated desired conditions and are accompanied by measurable objectives and thresholds. Without these, significant cumulative impacts might go unnoticed or undisclosed. Thresholds could alert managers to reassess the efficacy of a plan or implement protective management standards until more information becomes available. Thresholds could be given as a range of conditions, which, if met, would trigger a change in management strategy. The alternative is to proceed blindly until clear scientific evidence of a problem surfaces. There also are approaches that allow for assessment in light of uncertainty and can incorporate new information as it becomes available. For example, viability and sensitivity analyses can be used in the context of alternatives analysis to compare relative predicted effects (Mills 2007). Bayesian approaches can be used to incorporate prior knowledge, uncertainty, and knowledge about surrogate species to model biological effects (Marcot et al. 2001, Wenger 2008).

Large-scale assessments are essential for understanding biological effects at meaningful scales and should be undertaken as part of the agency's broader planning strategy. These assessments could inform project-level planning and incorporate data from project-level monitoring. Ensuring the strong scientific foundation of such assessments is key to effective planning. The Committee of Scientists (1999) suggested several possible ways forward, including increased use of science advisory boards overseen by USFS research, peer review of agency documents when appropriate, open acknowledgement of uncertainty in planning, and the use of science consistency checks for processes such as forest planning. These recommendations could be addressed or included in future practices and regulations.

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